Simulation Working Group Summary

- Generated complete list of all codes used at workshop.
- Began sorting codes by fidelity, roughly correlated to time/length scales achievable, critical when discussing priorities vs. effort to implement.
- Significant progress on generating a suite of possible benchmarks for code-to-code comparisons, each testing a particular physics package (i.e., diffusion, Shocks, B-field, neutron TOF.) Why? Good way to benchmark new physics put into a particular code in an accurate fashion.
- Idea of "unit tests" or "experimental benchmark experiment database born.
- List, then rank, the "top 10 places that kinetic effects show up." Then rank by some combination of importance vs. difficulty.

Test Problems Identified to test various “beyond simple fluid” simulation capabilities.

- George Zimmerman — H/He slab with initial grad(T). Run with hydro on, but still keep e-I coupling off. Run with 2 & 4 species..
- Nels Hoffman — H/Ne shock tube. Do multi-fluid & particle codes get rid of the dip in Ne behind shock?
- Claudio Bellei — mix phenomenon due to chock advection across interface
- Luis Chacon — Guderley spherical shock reflection. Both in and out of fluid regime. Tests ability of “high fidelity” codes to do fluids and fluid codes to include viscosity. Maybe a multi-species version.
- Jeff Greenough — Richtmyer-Meshkov shock turbulence modified to include effects of species diffusion and viscosity
- Drew Higginson — neutron TOF tests
- George Zimmerman — Guy Schurtz nonlocal electron transport linear test problem (We did not talk about this, but we cannot just ignore electrons)
- Eric Vold — Hoffman's H/Ne shock tube, but using electron energy source instead of piston. Where does the excess Ne end up if not at the piston?
- Scott Wilks — D/Ar interface diffusion test. Maybe with other nuclides to change Z/A & maybe with N>2 species.

I think we want the volunteer to provide results along with the test description. It assures that they have thought through everything & gives others a check on whether they are running the correct problem. It does run the risk that others could modify their results until they agree, but I doubt if that is an issue.

First cut at aligning kinetic effect with proposed experiements, with proposed simulation test problems

Rank	Phenomenon/Experiment	Will affect	Impact	Difficulty to address	Simulation Test Case
1	Knudsen Layer (Petrasso) (Chacon/Taitano/Cohen)	Burn	High	Hard	Knudsen Layer
2	Multi-species Shock separation (Ping)	Entropy in hot spot	Unknow n	Medium (new p/n/ diagnostic)	Mu-Sp Shock Tube Problem
3	Ablator-Wall interpenetration (Divol-LePape)	Symmetry	High	Medium	Interpenetration
4	Ion-ion equilibration in hot spot (Frenje)	Burn	Medium	Easy	Mult-Sp Shk Tube
5	Shock heating (Hans: vary Z/A)	Entropy of fuel	High	Easy	Mu-Sp Shock Tube
6	Magnetic fields around filaments (C. Li)	Transport	Medium	High	B-field Problem
7	Diffusion/Plasma Mix (Fernandez)	Transport/Burn	Medium		Diffusion
8	Shock heating (Hans: vary Z/A)	Fuel Entropy/ Burn	Medium	Easy	Mu-Sp Shock Tube
9	Hot electron anisotropy (Afeyan)	Symmetry	High	Medium	?
10	Knudsen/Wetted Foams (Olsen)	Burn	High	Medium	Knudsen layer

List of codes (and contact) used in simulation results presented at workshop.

- “Classic” Fluid
  - RIK (Reduced Ion Kinetic) & ZPKZ (Zimmerman, Paquette, Kagan, Zhdanov) Fluid code (George, Darwin, Nels)
  - HYDRA (Marty)
  - Ares (Greenough)
  - Miranda (Bill)
  - DUED (Stefano)
  - Fluid (Claudio)
  - Lilac and Draco (LLE)
  - Rage and xRage(LANL)
- Vlasov Fokker-Planck
  - FPion, FUSE (Olivier)
  - iFP (Luis, Will)
  - Oshun (Archis)
- Particle-In-Cell (PIC)
  - PSC (Andreas)
  - VPIC (Fernandez)
  - OSIRIS (Warren)
- PIC + Particle fluid (Hybrid) –
  - LSP (Carsten, Le)
  - ePlas (Rod)
  - Icepic (Bruce)
- MOD-MD (Michael)

Spectrum of Fidelity

Radiation

Multi-group Diffusion

Ray trace

IMC

Sn

Maxwell's Equations

Matter

Multi-component Hydrodynamics

Single Species Hydrodynamics

Multi-species hydrodynamics

Hybrid PIC/Hydro

Vlasov-FP

Particle-In-Cell

Molecular Dynamics

Scale Lengths

L ~ 1 cm

L ~ 1 mm

L ~ 100 um

L ~ 1 um